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ELECTRIC SWITCH

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17 Claims. (Cl. 200—153)

The invention relates to electrical switches in general, and more particularly to switches adapted to carry heavy currents.

In knife blade type switches of large current capacity, it is extremely important that the contact portions of the blades make good electrical contact with the stationary hinge and break contacts. One commonly used arrangement for securing good electrical contact between the blades and stationary contacts has been to provide pairs of cup washers adjacent each end of the switch which are drawn towards each other by bolts and nuts to secure a pressure engagement between the blades and the stationary contacts. An arrangement of this type is illustrated in Fig. 4 of Patent No. 2,009,815, issued July 30, 1935. The cup washers are radially slotted in order to provide the necessary resiliency.

In arrangements of this type when the nuts are tightened to apply lateral pressure against the blades, the radial fingers of the washer are spread outwardly increasing the outside diameter of the washer. A very small fraction of a turn of the nut multiples the contact pressure a considerable amount. This arrangement has not proved entirely satisfactory because of the fact that the cup washers lack the desired amount of flexibility to compensate for wear of the contact surfaces; a relatively slight amount of wear of the contact surfaces results in a considerable reduction in the contact pressure. Furthermore, the spreading of the radial fingers introduces undesirable sliding friction between the edges of the washers and the outer surfaces of the blades and these edges are apt to cut into the surface of the blade and thus jam. There is also an unequal distribution of stresses through the cup washer which is objectionable.

An object of the invention is the provision of an improved electrical disconnect switch which is simple, efficient and reliable in operation and inexpensive to manufacture.

Another object of the invention is the provision of an electric switch embodying an improved contact pressure securing means.

Another object of the invention is the provision of a knife blade type electric switch embodying improved resilient means for securing good electrical conductivity between the blade means and the stationary contacts.

Another object of the invention is the provision of an electric switch with an improved spring washer which has greater flexibility and which is more efficient and reliable in operation than spring washers that have heretofore been known or used.

Another object of the invention is the provision of a switch embodying an improved means associated with both the hinge and break contact portions of the switch for increasing the conductivity of the switch.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof will best be understood from the following detailed description of several embodiments thereof when read in connection with the accompanying drawings in which:

Figure 1 is a side elevational view of an electric switch embodying the features of the invention;

Fig. 2 is a plan view of the switch illustrated in Fig. 1;

Fig. 3 is an enlarged elevational view of one of contact pressure securing plates or washers associated with the switch illustrated in Figs. 1 and 2;

Fig. 4 is a vertical sectional view of the washer illustrated in Fig. 3, the washer being shown in unstressed condition;

Fig. 5 is a sectional view similar to Fig. 4, illustrating the washer when lateral pressure is applied to the central portion thereof;

Fig. 6 is a fragmentary sectional view of the break end of a switch embodying a modified form of spring washer means;

Fig. 7 is an enlarged sectional view of one of the spring washers illustrated in Fig. 6;

Fig. 8 is a fragmentary plan view of the hinge end of a switch embodying the form of spring washer illustrated in Fig. 7; and

Fig. 9 is an elevational view of a further modified spring washer construction.

Referring to the drawings, particularly Figs. 1 and 2 thereof, the switch illustrated is of the single-pole, single-throw type and comprises, in general, a base 9, a pair of spaced and insulated contact members 11 and 13, a cooperating blade means indicated generally at 15 and means for increasing the conductivity of the switch indicated generally at 17.

The base 9 which forms the main support for the switch consists of a channel shaped member of any suitable rigid material such as iron or steel. The contact members 11 and 13, the member 11 forming a break contact and the member 13 forming a hinge contact, are composed of suitable conducting material such as copper or a suitable copper alloy, and are supported in spaced relation on the base 9 by a pair of insulating columns 19 of vitreous insulating material. The columns 19 serve to insulate the contact members from each other and from the base 9. The contact members 11 and 13 are secured in any suitable manner as by welding to terminal plates 21, of conducting material, which serve to connect the switch in an electrical circuit. The terminal plates 21 are in turn secured to the metal cap

pieces 23 of the insulating columns 19 by bolts 25.

The blade means 15 of the switch comprises a pair of parallel flat bars 27 of suitable conducting material such as copper or the like which are pivoted at their one end on the hinge contact member 13 by means of a through bolt 29. The blades 27 are secured for pivotal movement together by means of a second through bolt 31, and are spaced the proper distance apart adjacent the break contact 11 by a suitable spacer means 33. The blades 27 are adapted to be swung into and out of engagement with the break contact member 11, and this member is suitably notched as indicated at 35 to accommodate the through bolt 31 which connects the blades together. The free ends of the blades 27 are perforated as indicated at 37 to form an operating eye for receiving a pull rod, hook stick, or other form of operating means for operating the switch.

The means for increasing the conductivity of the switch comprises two pairs of spring washers 39 associated with the blades adjacent each of the stationary contact members. The washers 39 are mounted on opposite sides of the blade means 15 with their outer edges in contact with the outer surface of the blades 27. The washers are held in mounted position by means of the through bolts 29 and 31 and cooperating nuts 41.

Each spring washer comprises an annular member of suitable conducting material such as copper alloy, phosphor bronze, or spring steel which is deformed into a concavo-convex shape as more clearly indicated in Fig. 4. The washer is provided with a series of arcuate slots 43 disposed in concentric relation with respect to the axis of the washer, there being four series of such slots in the embodiment illustrated. The series of slots are each spaced different radial distances from the axis of the washer, and the slots of each series lie along different median radii from the slots of the next adjacent series so that they are positioned in staggered relation. In the embodiment illustrated there are at least two slots along each radius. The provision of the slots 43 and their particular arrangement renders the washer 39 compressively resilient so that the same functions somewhat in the manner of a conical spring. The normal position of the washer 39 when not subjected to lateral pressure is illustrated in Fig. 4. When lateral pressure is applied to the washer to compress the same, the washer tends to flatten out in the manner illustrated in Fig. 5 until its reactive force equals the applied pressure or force. It will be noted that the outside diameter of the washer remains constant during compression due to the provision of the arcuate slots and their particular arrangement, the slots tending to close up during compression and to open when the pressure is relieved.

When the nuts 41 on the bolts 29 and 31 are tightened, the spring washers 39 are compressed and act to resiliently bias the ends of the blades 27 laterally toward one another to secure a high pressure engagement of the contact surfaces of the blades with the cooperating contact surfaces of the contact members 11 and 13. The high pressure engagement of the contact surfaces effected by the spring washers 39 materially increases the conductivity of the switch adapting the same for carrying large values of current.

When the switch is in the open position, the spring washers 39 adjacent the break end of the blades bias the ends of the blades toward each other so that they assume a position in which the distance between the inner surfaces of the blades is slightly less than the distance between the outer surfaces of the break contact member 11. In order to facilitate closing of the switch, the upper portion of the contact member 11 is tapered a sufficient extent to allow the upper end of the contact member 11 to enter between the blades 27 during closing of the switch. During the latter part of the closing operation the tapered sides of the contact member 11 exert a wedging action to spread the blades apart against the biasing action of the spring washers 39 to effect a high pressure engagement between the cooperating contact surfaces of the blades and contact member 11.

The provision of the series of arcuate slots in the washers 39 and their particular arrangement provides a substantially equal distribution of the stresses throughout the washer and increases its flexibility. The increased flexibility of the washer over the prior art washers heretofore mentioned prevents the wearing down of the contact surfaces from effecting any substantial decrease in the contact pressure. A further important advantage of the spring washer described is that its outside diameter remains substantially constant during compression thus eliminating sliding friction between the edges of the washer and the surfaces of the blades.

A modification of the invention is illustrated in Figs. 6, 7 and 8. In Fig. 6 is shown the break end of a disconnecting switch comprising a pair of blade members 51 and a stationary break contact member 53. In this modification of the invention, the means for increasing the conductivity of the switch comprises a pair of washers 55 somewhat similar in structure to the washer described in connection with Figs. 1 through 5. The washers 55 are provided with a series of arcuate concentrically disposed slots 56 similar to the slots 43 of the washer 39 shown in Fig. 3 and described in connection therewith. The washers 55 are composed of suitable conducting material and are deformed to provide raised annular contact portions 57 at opposite sides for engaging the contact member 53 and the blade 51, respectively. The washers 55 are secured to the inner surfaces of blades 51 in any suitable manner as, for example, by means of the rivets 58 as illustrated in Fig. 6 so that their central openings align with the openings 59 provided in the blades for the reception of the through bolt 61. A suitable spacer means 63 is provided for spacing the blades 51 the proper distance apart. A nut 65 is screwed onto the through bolt 61 and is tightened to provide a predetermined contact pressure between the contact surfaces 57 of the washers 55 and the cooperating contact surfaces of the contact member 53 and blades 51 when the switch is closed. The concentrically disposed raised contact portions 57 of the spring washer 55 restrict the contact area to the order of line contacts and the resiliency of the washer when the nut is tightened provides a high contact pressure between the cooperating contact surfaces. The restriction of the contact area to the order of line contacts and the resilient pressure effected by the spring washers materially increases the conductivity of the switch.

In Fig. 8, the modified form of washer means is illustrated as applied to the hinge end of the switch. The switch comprises a pair of blades 67 which are pivotally mounted on a stationary hinge contact 69 by means of a through bolt 71. A pair of spring washers 73 similar to the washers 55 described in connection with Fig. 6 are

loosely disposed on the through bolt 71 between the hinge contact member 69 and the inner surfaces of the blades 67, on opposite sides of the contact member 69. A nut 75 is screwed on the end of the through bolt 71 for the purpose of drawing the blade members 67 laterally toward one another to increase the contact pressure of the hinge joint. Each of the washers 73 is composed of suitable conducting material and is deformed to provide raised annular contact portions 77 projecting from the opposite faces thereof. The raised annular portions 77 are concentrically disposed with respect to the axis of the washer and are located at different distances from the axis. Each washer 73 is provided with a series of concentric arcuate slots 78 similar to the slots 43 in the spring washer 39 shown in Fig. 3 and described in connection therewith. The arcuate slots render the washer compressively resilient.

When the nut 75 is tightened, the washers 73 are compressed to effect a high pressure engagement between the annular contact portions 77 and the contact surfaces of the hinge member 69 and blades 67. The annular raised contact portions 77 serve to restrict the contact area to the order of line contacts and this, coupled with the resilient pressure exerted by the washers, materially increases the conductivity of the switch.

The spring washers 55 and 73 may be composed of any suitable conducting material, preferably one having a high conductivity and whose conductivity is substantially unaffected by corrosion such as silver or the like. Instead of being solid silver, the spring washers 55 and 73 may be of laminated construction as illustrated in Fig. 7 having a central portion 79 of copper or copper alloy, and outer portions 81 of silver. The silver portion 81 may either be welded, sprayed or plated on the surfaces of the washer.

The form of washer means illustrated in Figs. 6, 7 and 8 eliminates the necessity of any outside cup washers for securing a high pressure contact between the blades and the contact members.

A further modified form of spring washer for use with an electrical switch is illustrated in Fig. 9. The washer comprises an annular member 83 of resilient material which is deformed to have a concavo-convex form as in the case of the spring washer shown in Fig. 3. The washer 83 is provided with a plurality of curved slots 85 extending spirally outwardly from the central portion towards the outer edge of the washer to render the same compressively resilient. The slots 83 do not extend through either edge of the washer so that its inner and outer edges remain continuous and unbroken as in the case of the previously described washers. This causes the inside and outside diameters of the washer to remain constant during compression eliminating sliding friction between the edges of the washer and the surfaces which they engage. The washer 83 is adapted to be mounted on the through bolt of the switch with its outer edge in contact with one of the blades in the same manner as the washer 39 illustrated in Figs. 1 and 2.

It will be readily understood that the slots of the washer may have a number of different sizes and shapes such as will render the washer compressively resilient. The slots, however, should not extend through the edges of the washer if it is desired that the inside and outside diameters remain constant during lateral compression.

In all of the previously described modifications the number of slots may be increased or decreased depending on the amount of resiliency or flexibility desired.

While the modifications of the invention have been described in connection with a particular type of disconnecting switch, it is obvious that it is equally applicable to various other types of electrical switches. Various changes in the structural details may be made without departing from the spirit of the invention. It is desired, therefore, that the language of the accompanying claims be given the broadest reasonable construction possible in the light of the prior art.

I claim as my invention:

1. In an electric switch, a stationary contact means and a cooperating blade means movable into and out of engagement therewith, one of said means having portions at the opposite faces of the other in the closed position of the switch, means for increasing the conductivity of the switch comprising yielding means of conducting material secured to one of said aforementioned means so as to be disposed between the contact surfaces of the contact means and blade means when the switch is closed, said yielding means having raised annular contact surfaces at opposite sides for pressure engagement with the contact surfaces of said contact and blade means to restrict the contact area to the order of line contacts.

2. In an electric switch, a stationary contact means and a cooperating blade means movable into and out of engagement therewith, one of said means having portions at the opposite faces of the other in the closed position of the switch, means for increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of the contact means and blade means when the switch is closed, said yielding means having raised annular contact surfaces at opposite sides for pressure engagement with the contact surfaces of said contact and blade means to restrict the contact area to the order of line contacts, said yielding means having contact surfaces of a material having high conductivity and whose conductivity is substantially unaffected by corrosion.

3. In an electric switch, a stationary contact means and a cooperating blade means movable into and out of engagement therewith, one of said means having portions at the opposite faces of the other in the closed position of the switch, means for increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of the contact means and blade means when the switch is closed, said yielding means having raised annular contact surfaces at opposite sides for pressure engagement with the contact surfaces of said contact and blade means to restrict the contact area to the order of line contacts, said yielding means having a series of slots formed therein to render the same compressively resilient.

4. In an electric switch, a stationary hinge contact means and a cooperating blade means pivoted thereon, one of said means having portions at the opposite faces of the other of said means, means increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of said blade means and said contact means, said yielding means having raised annular contact surfaces on opposite sides for engaging said blade

and contact means to restrict the contact area to the order of line contacts and means for drawing said portions of said one means laterally toward one another to provide a predetermined contact pressure.

5. In an electric switch, a stationary hinge contact means and a cooperating blade means pivoted thereon, one of said means having portions at the opposite faces of the other of said means, means increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of said blade means and said contact means, said yielding means having raised annular contact surfaces on opposite sides for engaging said blade and contact means to restrict the contact area to the order of line contacts and means for drawing said portions of said one means laterally toward one another to provide a predetermined contact pressure, said yielding means having contact surfaces of a material having a high conductivity which is substantially unaffected by corrosion.

6. In an electric switch, a stationary hinge contact means and a cooperating blade means pivoted thereon, one of said means having portions at the opposite faces of the other of said means, means increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of said blade means and said contact means, said yielding means having raised annular contact surfaces on opposite sides for engaging said blade and contact means to restrict the contact area to the order of line contacts, and means for drawing said portions of said one means laterally toward one another to provide a predetermined contact pressure, said yielding means having a series of slots formed therein to render the same compressively resilient.

7. In an electric switch, a stationary contact means and a cooperating blade means, one of said means having portions adapted to be disposed opposite the faces of the other of said means, means increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of the aforementioned means, said yielding means being provided with raised annular contact surfaces on opposite sides for engaging the contact surfaces of said contact and blade means to restrict the contact area to the order of line contacts and to provide a predetermined contact pressure.

8. In an electric switch, a stationary contact means and a cooperating blade means, one of said means having portions adapted to be disposed opposite the faces of the other of said means, means increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of the aforementioned means, said yielding means being provided with raised annular contact surfaces on opposite sides for engaging the contact surfaces of said contact and blade means to restrict the contact area to the order of line contacts and to provide a predetermined contact pressure, said yielding means having a series of slots formed therein to render the same compressively resilient.

9. In an electric switch, a stationary contact means and a cooperating blade means, one of said means having portions adapted to be disposed opposite the faces of the other of said means, means increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of the aforementioned means, said yielding means being provided with raised annular contact surfaces on opposite sides for engaging the contact surfaces of said contact and blade means to restrict the contact area to the order of line contacts and to provide a predetermined contact pressure, said yielding means having surfaces of a material having a high conductivity and whose conductivity is substantially unaffected by corrosion.

10. In an electric switch, a stationary contact means and a cooperating blade means, one of said means having portions adapted to be disposed at the opposite faces of said other means, means for increasing the conductivity of the switch comprising yielding means of conducting material disposed between the contact surfaces of the contact and blade means, said means having an annular portion offset from one face and a second annular portion of different diameter from the first portion offset from the other face the said portions being in pressure engagement with the contact surfaces of the contact and blade means to restrict the contact area to the order of line contacts, and bolt means for effecting said pressure engagement.

11. A spring washer for an electric switch comprising an annular member of conducting material deformed to have portions in parallel planes spaced from and on opposite sides of its principal plane, said washer having a series of curved slots formed therein to render the same compressively resilient, the edges of the washer being unbroken.

12. A spring washer for an electric switch comprising an annular member of conducting material deformed to have portions in parallel planes spaced from and on opposite sides of its principal plane, said washer having a series of arcuate slots formed therein which are concentrically disposed with respect to the axis of the washer, each series of slots having a different radius, and the slots of each series lying on different median radii from the slots of the next adjacent series.

13. A spring washer for an electric switch comprising an annular member having a series of curved slots formed therein, said slots being disposed so that the edges of said member are not joined by said slots.

14. A spring washer for an electric switch comprising an annular member provided with a series of arcuate slots concentrically disposed with respect to the axis of the washer, each series of slots having a different radius, and the slots of each series lying on different median radii from the slots of the next adjacent series.

15. A spring washer for an electric switch comprising an annular member of conducting material formed to provide raised annular portions projecting from the opposite faces thereof.

16. A spring washer for an electric switch comprising an annular member of conducting material formed to provide raised annular portions projecting from the opposite faces thereof, said member having a series of slots formed therein to render the member compressively resilient.

17. A spring washer for an electric switch comprising an annular member of conducting material formed to provide raised annular portions projecting from the opposite faces thereof, said raised portions having silver surfaces.

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ELECTRIC SWITCH

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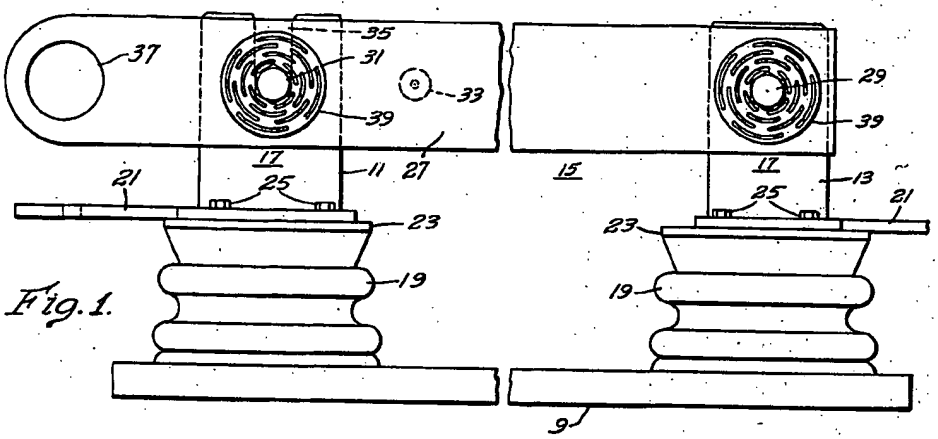

Fig. 1.

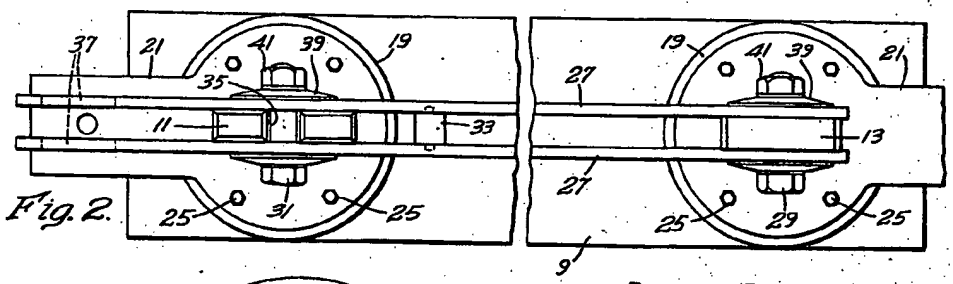

Fig. 2.

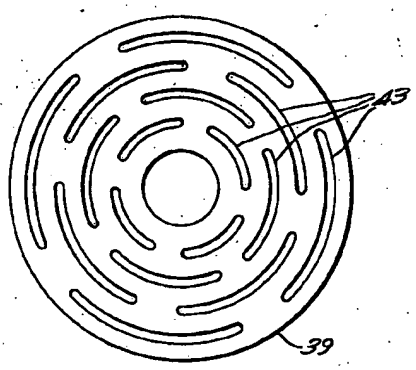

Fig. 3.

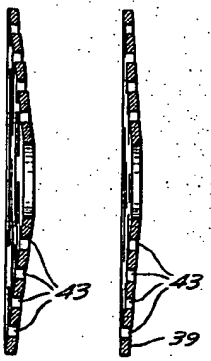

Fig. 4.

Fig. 5.

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ELECTRIC SWITCH

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Fig. 6.

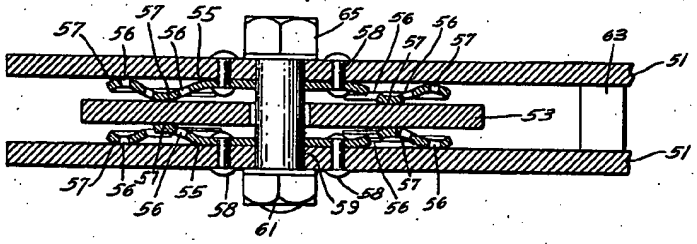


Fig. 7.

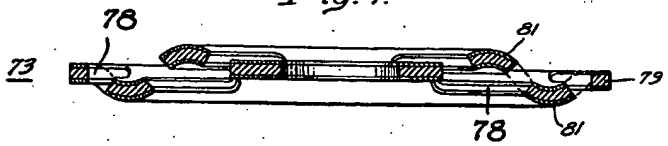


Fig. 8.

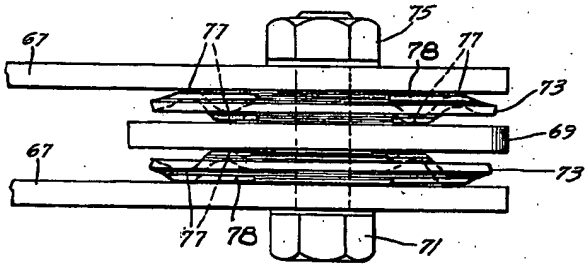
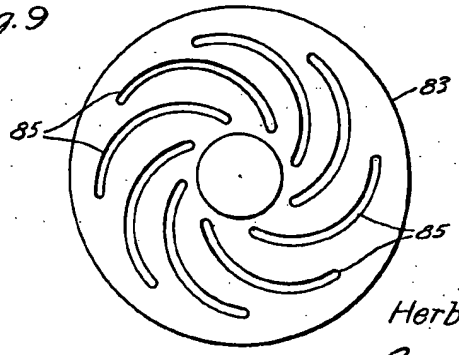


Fig. 9



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